Developments in Global Aerosol Modelling

Ken Carslaw, Graham Mann, Dominick Spracklen, Hannele Korhonen,
Paul Manktelow, David Ridley, Joonas Merikanto, Martyn Chipperfield

http://researchpages.net/glomap Contact k.s.carslaw@leeds.ac.uk

UNIVERSITY OF LEEDS

Introduction

NERC, NCAS and APPRAISE are supporting the development of advanced global aerosol models for climate and air quality research.

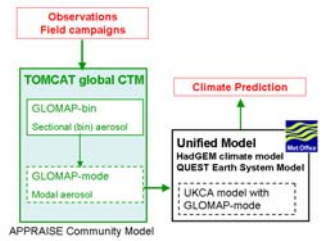
This poster describes some current model applications and future developments

The models are called GLOMAP – Global Model of Aerosol Processes

GLOMAP-mode: a fast size-resolved model using size modes is now incorporated in UM6.6

GLOMAP-bin: a bin-resolved model for very detailed studies of global aerosol

Both models run side by side in the TOMCAT CTM



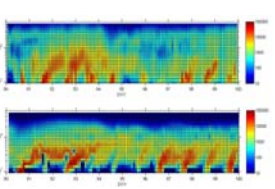
Our aim is to make a strong connection between the future development of the UM (UKCA) aerosol scheme and new observations and process knowledge

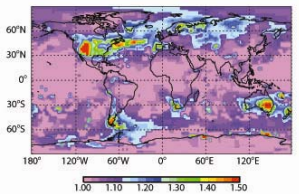
There are many advantages of having the same aerosol schemes in a CTM and GCM

Nucleation

New parameterizations of boundary layer nucleation have been included in GLOMAP in collaboration with the University of Helsinki

The process greatly improves comparison with observed size distributions





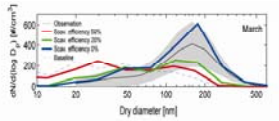
We calculate a significant impact on cloud condensation nuclei

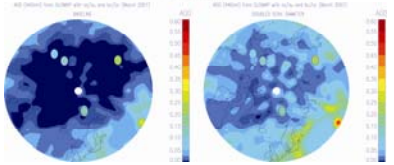
Spracklen et al., ACP 2006; GRL submitted 2007

Arctic Aerosol

Arctic aerosol is important in the regional radiative balance and warming trend

Using GLOMAP, we have uncovered major issues related to long-range transport and wet deposition, possibly related to mixed-phase clouds





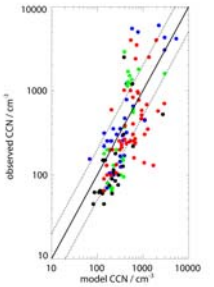
Model AOD compared to sun photometer measurements before and after optimising aerosol scavenging

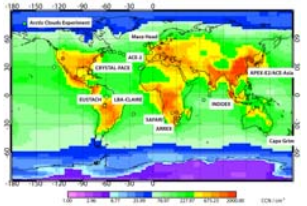
Korhonen et al., 2007 JGR in press.

Global CCN

Climate models haven't previously calculated cloud condensation nuclei concentrations explicitly

Here we make a fist comparison of model CCN with 20 years of measurements around the world





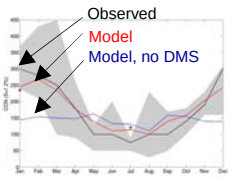
Evaluation of such a fundamental aerosol quantity will improve our understanding of the indirect effects

Marine DMS and CCN

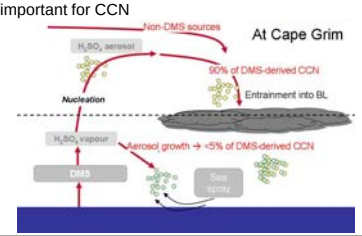
SOLAS is funding this research.

A global aerosol microphysics model is an ideal tool for working out what controls marine CCN concentrations.

CCN at Cape Grim➔



By switching off various processes we find that >90% of DMS-derived CCN in the Southern Ocean originate from the free troposphere. Growth of ultrafine sea spray is unimportant for CCN



Global Sulphate Budget

We have used the GLOMAP-mode in the TOMCAT CTM to understand how changes in regional sulphur emissions impact the global sulphate aerosol budget.

Table shows 1985 budget and changes to 2000. Compare the changes in SO_2 emission and in-cloud oxidation in Europe and Asia.

	1985	% DIF	1985	% DIF	1985	% DIF
SO_2 Emission	2.8	-26.3	3.7	-47.4	3.36	31.5
Gas Phase Ox	0.34	-23	0.26	-50.0	0.42	44.1
In Cloud Ox	0.58	-9.2	0.68	-22.6	0.7	30.3
SO_2 Deposition	1.56	-30.1	1.96	-56.8	1.9	20.9
SO_2 Burden	2.8	-20.4	4.5	-53.9	4.1	13.9
Sulfate Burden	1.8	-16.9	3.2	-31.5	2.6	27.7

Between 1985 and 2000 S emissions moved southward where SO_4 production is less oxidant limited. The 12% reduction in global SO_2 emissions between 1985 and 2000 caused only a 3% decrease in global sulfate.

Manktelow et al., Geophys. Res. Lett., 2007

Other research

Core model development is supported by NCAS and APPRAISE, but other projects have significant input.

- In QUEST we will include new SOA schemes developed at Manchester.
- In SOLAS we are coupling GLOMAP to the halogen cycle.
- Through a Met Office CASE student we are studying DMS-dust-climate links.
- The GLOMAP CTM will be used in field campaigns (ADIENT, EUCAARI) in 2008, for which we are developing a regional zoom version of TOMCAT.

Want to get involved? The models will be available to the community through APPRAISE and UKCA in 2008